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Original Article

Peripheral neuropathy in type-II diabetic patients attending diabetic clinics in Al-Azhar University Hospitals, Egypt

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ABSTRACT

Background: Peripheral neuropathy (PN) is a common neurological complication in patients with diabetes mellitus (DM) which affects their quality of life.
Objective: To determine the frequency of PN and the risk factors associated with its occurrence in the studied diabetic patients.
Subjects and methods: A cross sectional study was conducted in Al-Azhar University Hospitals, Cairo, Egypt. The study recruited 300 patients with type-II DM who attending the outpatient diabetic clinics in the studied hospitals, from October 1st 2005 through January 2006. A clinical neurological examination was conducted for all patients using the Michigan Neuropathy Diabetic Scoring (MNDS) criteria for diagnosis of PN. Subsequently, we considered patients with PN as study cases, and those without PN as controls to assess the risk factors associated with PN. Statistical analysis including multivariate logistic regression analysis was done.
Results: The frequency of PN among the studied subjects was 29.7%. Related risk factors were: older age above 60 years (odds ratio (OR) = 73.0; 95% confidence interval (CI) = 14.2–377.2), associated moderate to severe hypertension (OR = 10.2; 95% CI = 2.8–38.0) and associated ischemic heart disease (IHD) (OR = 3.80; 95% CI = 1.50–9.80), poor control of DM (OR = 9.1; 95% CI = 2.6–32.1), and duration of DM. The risk of PN, however, was significantly reduced among married patients and those reported high educational and family income levels.
Conclusions: Diabetic PN is a considerable complication of DM. The related risk factors were old age, prolonged and poorly controlled DM and associated medical disorders.

1. Introduction

Diabetes mellitus (DM) is one of the most widespread chronic diseases in the world. Nearly 10% of Egyptian people are affected by DM type-II in 2000 and this figure is expected to increase to 13.3% in 2025 [1]. DM has two types of complications: microvascular and macrovascular. One of the most frequently-occurring microvascular complications is diabetic neuropathy, of which the most common type is distal symmetrical neuropathy or peripheral neuropathy (PN) [2]. Complications of PN include severe pain, loss of ambulation and increased risk of foot ulceration and amputation [3].

Incidences of diabetic PN have been reported in 10–50% of patients with diabetes mellitus in Western countries [3]. At the time of diagnosis, PN is present in 10% of diabetic patients and overall in 50% of patients with a 25-year history of the disease [4]. The incidence of PN in diabetic children was 10% in a study conducted in Alexandria, Egypt, and included 20 children with type-I diabetes mellitus [5]. Several epidemiological studies have been proposed to explain the various risk factors influencing the occurrence and progression of PN. The prevalence of PN is found to be closely associated with high blood pressure (BP), hyperlipidemia and cigarette smoking [6]. Older age of diabetic patients, duration of the disease and poor diabetic control were also found to have a significant role in the occurrence of PN [7,8].

Peripheral neuropathy is the first step in the generation of diabetic foot ulcer. Foot ulcers develop in risk areas that are exact pressure points. If not detected early, these lesions may progress to gangrene and result in amputation [6]. It has been found that the life-time risk of foot amputation to be 15% in patients with diabetic PN [9]. Identification of the risk factors associated with PN is important to decrease its occurrence, preventing the associated secondary complications, and improving the quality of life for diabetic patients [9]. Since there is no regional evidence concerned with this important diabetic complication, except that conducted in Alexandria and which was only concerned with type-I DM in children, this study aimed to explore the prevalence of PN among

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type-II diabetic patients and to assess the risk factors influencing the occurrence of PN among them.

2. Patients and methods

In this cross sectional study, we recruited 300 diabetic patients from the diabetic outpatient clinics at Al-Azhar University Hospitals. In this study, we calculated the prevalence of peripheral neuropathy (PN). We also used a nested case-control approach to examine the risk factors associated with PN among the studied patients. Patients with PN were considered as the study cases and those without PN were considered as controls. During recruitment, we excluded patients with specific neurological disease, such as stroke, loss of dorsalis pedis pulses and those with less than one year duration of disease. We took a written consent from the patients before they were enrolled in the study.

Diagnosis of PN to determine its prevalence among the studied patients and to differentiate between the studied cases and controls was performed, by using Michigan Neuropathy Diabetic Scoring (MNDS) [10]. This system gives a score in the range 0–8, based on evaluation of 4 different factors in each leg. These factors are: appearance of foot (dry skin, callus, deformities, fissure, and infection), presence of ulcer, vibration perception in the great toe (measured with a 128 Hz tuning fork), and Achilles tendon reflex. The components were given a score of 0.5 or 1 on the basis of the relevant signs. This scoring system has a sensitivity and specificity of nearly 95%. A neuropathic foot usually scores 3 or higher, a normal foot 2.5 or lower [11].

Detailed information was collected on each patient's age, sex, education, occupation, family income, marital status, height, weight, smoking status, duration of diabetes mellitus, degree of blood glucose control (poor, fair, good), presence of hypertension and ischemic heart disease (IHD), and family history of DM. The quality of diabetes control was classified as Good control if fasting blood glucose (FBG) < 110 mg/dl, fair control if FBG ⩾ 110 and <130 mg/dl, and poor control if FBG ⩾ 140 mg/dl. Seated blood pressure was measured in the right arm, to the nearest 2 mm Hg with a random zero sphygmomanometer and the mean of two readings [for both systolic blood pressure (SBP), and the diastolic blood pressure (DBP)] was recorded. Hypertensive patients were identified according to the sixth report of the Joint National Committee on prevention, detection, evaluation and treatment of high blood pressure [12], ischemic heart disease (IHD) was diagnosed by history and electrocardiographic abnormalities [13], and fasting blood sugar (FBS) by the glucose oxidase method (Pars Azmoon kit).

The collected data were analyzed by using the software package (SAS). In order to compare the distribution of demographic and other studied factors of the studied patients, we used χ^2 tests for the categorical variables and t test for the continuous variables. We also used multivariate logistic regression models to estimate odds ratios and their 95% confidence intervals for the association of PN with the studied variables [14], while controlling for the possible covariates.

3. Results

Of the 300 diabetic patients, there were 89 (29.7%) patients diagnosed as having diabetic peripheral neuropathy (PN). The mean age of all the studied subjects was 48.1 ± 11.3 (18–75 years), and the average duration of disease was 8.2 ± 4.9 years. The male patients were 158 (52.7%) and the female patients were 142 (47.3%). Table 1 compares the sociodemographic characteristics among cases and controls. With the exception of sex distribution and occupation, there have been statistically significantly differ-

Table 1
Comparison of sociodemographic characteristics between the studied diabetic patients with and without peripheral neuropathy (PN).

Characteristics	Patients with PN (cases)		Patients without PN (controls)		*P*-value
	No.	%	No.	%	
Age (years)					
<50	16	18.0	178	84.4	
50–60	44	49.4	31	14.6	
>60	29	32.6	2	1.0	<.0001
Sex					
Male	52	41.6	106	49.8	
Female	37	58.4	105	50.2	0.19
Education					
Illiterate	64	72.0	67	31.7	
Less than secondary	4	5.0	87	41.3	
Secondary and higher	21	23.0	57	27.0	<.0001
Occupation					
Unskilled	58	65.0	139	66.0	
Skilled	18	20.0	39	18.0	
Employee	13	15.0	33	15.0	0.51
Marital status					
Married	39	44.0	45	21.0	
Un-married	50	56.0	166	79.0	<.0001
Family income					
Low	65	73.0	118	56.0	
Moderate	16	18.0	60	28.4	
High	8	9.0	33	15.6	0.02

Table 2
Adjusted odds ratio (OR) and 95% confidence interval (CI) for the association of sociodemographic and lifestyle factors with peripheral neuropathy in the studied diabetic patients.

Sociodemographic and lifestyle factors	Patients with PN (cases)	Patients without PN (controls)	OR[a]	95% CI
Age (years)				
<50	16	178	1.00	Ref.
50–60	44	31	12.9	5.9–12.0
>60	29	2	73.0	14.2–377.2
Sex				
Female	37	105	1.00	Ref.
Male	52	106	1.40	0.85–2.30
Education				
Illiterate	64	67	1.00	Ref.
Less than secondary	21	87	0.25	0.14–0.45
Secondary and higher	4	57	0.10	0.03–0.21
Occupation				
Unskilled	58	139	1.00	Ref.
Skilled	13	39	0.80	0.40–1.60
Professional	18	33	1.30	0.70–2.50
Marital status				
Un-married	39	45	1.00	Ref.
Married	50	166	0.35	0.20–0.60
Family income per month				
Low	65	118	1.00	Ref.
Moderate	16	60	0.50	0.26–100
High	8	33	0.45	0.20–0.98
Smoking status				
Never	51	161	1.00	Ref.
Ex-smoker	19	5	2.00	0.50–8.50
Current smoker	19	45	0.98	0.43–2.21
Body mass index (BMI)				
<25	60	123	1.00	Ref.
25 to <30	26	61	1.50	0.71–3.30
⩾30	3	27	0.40	0.10–1.50

[a] OR of each studied variable is adjusted by other ones included in this table.

Table 3
Adjusted odds ratio (OR) and 95% confidence interval (CI) for the association of diabetes mellitus related factors and associated medical disorders with peripheral neuropathy in the studied diabetic patients.

Studied factors	Patients with PN (cases)	Patients without PN (controls)	OR[a]	95% CI
Duration of diabetes				
<5 years	8	69	1.00	Ref.
5–10 years	32	115	3.10	1.22–9.40
>10 years	49	27	6.20	2.10–18.8
Diabetic control[b]				
Good	40	162	1.00	Ref.
Fair	29	43	1.60	0.66–3.35
Poor	20	6	9.10	2.60–32.1
Associated hypertension				
Normotensive	27	167	1.00	Ref.
Mild hypertension	32	40	1.25	0.55–2.78
Moderate to severe	30	4	10.2	2.75–38.0
Associated IHD				
No	55	195	1.00	Ref.
Yes	34	16	3.80	1.50–9.80
Family history of DM				
No	48	174	1.00	Ref.
Yes	41	37	4.01	1.20–8.90

[a] OR is adjusted by age and educational levels.
[b] Good control if fasting blood glucose (FBG) < 110 mg/dl, fair control if FBG ⩾ 110 and <130 mg/dl, and poor control if FBG ⩾ 140 mg/dl.

ences between cases and controls regarding all the studied sociodemographic variables. Cases were mostly older. The percentage of married cases, and those reporting positive family history of DM, was higher when compared to controls. Also, the percentage of cases in the lowest family income level was higher compared to controls.

Table 2 presents the association between PN and the studied sociodemographic factors. The most important factor associated with PN was the age of patients. Compared with patients aged less than 50 years, the adjusted ORs were 12.9 (5.9–12.0), and 73.0 (95% = 14.2–377.2) for patients aged greater than 60 years. The risk of PN is also increased 1.4 fold among male patients, although insignificant (OR = 1.40, 95% CI = 0.85–2.30). On the other hand, we found that increasing educational level and family income significantly reduced the risk. Similarly, the risk was reduced among married and obese patients. Compared to never smokers, no risk of PN was observed among current smokers while the risk was about two times among the ex-smokers, although insignificant (OR = 2.0; 95% = 0.50–8.50).

Table 3 shows the adjusted OR and their 95% confidence intervals for the association of PN with DM related factors and associated medical disorders. The results indicate that the longer the duration of DM, the higher the risk of PN. The risk is found to be three times higher among patients reporting a history of DM ranging from 5–10 years and to be six times more among patients with DM of more than 10 years. Poor diabetic control increases the risk of PN by about nine times (OR = 9.10; 95% CI = 2.60–32.1). Also, we found that, the associated severe hypertension and IHD increased the risk of PN; where the adjusted ORs were 10.2 (95% = 2.75–38.0) and 3.80 (95% CI = 1.50–9.80), respectively. The patients reported positive family history of DM were found to have four times the risk to developing PN, as compared with those without a family history of DM.

4. Discussion

Peripheral neuropathy is a common complication of DM, with impairment of quality of life and high morbidity. This hospital-based study found a considerable prevalence of PN among diabetic patients (29.7%). We also found several (?) factors which are significantly associated with an increased risk of PN. These factors include older age, duration of diabetes, poor control of diabetes and associated hypertension and ischemic heart diseases. The highest risk was among those older patients above 60 years (OR = 73.0; 95% CI = 14.2–377.2). We also found that other factors to decrease the risk of PN among the studied patients. These factors include marriage and high educational and family income levels.

The prevalence of PN observed in this study was similar to that reported in a previous large study, including 3250 diabetic patients, where the prevalence of PN was about 28% among them [15]. The results of our study also confirm previous reports regarding the association of PN with old age, duration of disease and poor diabetic control. Consistent with our study results, the previous studies have also shown associations of PN with old age [1,8], duration of disease [1,16] and poor diabetic control [17,18].

Cigarette smoking was found to be associated with an increased risk of PN in some of the previous studies [8,19]. In our study, however, no relationship was found between PN and current smoking, although ex-smokers are found to have double the risk when compared to never smokers. This observed difference might be explained by the finding that more healthy smokers continued smoking, while the less healthy stopped [20]. Our study results confirm this finding, as we actually found the risk to increase among ex-smokers.

The observed protective effect of marriage, increasing educational level and high family income appeared to be consistent with the results of studies that link better health care and self care knowledge and practice with higher educational and family income levels [21,22]. Moreover, marriage may buffer against stress and thereby reduce the activation of neuroendocrine system, which may lead to a reduction in atherosclerosis and other pathological processes [23]. The protective effect of obesity on the risk of PN observed in this study may be explained by the findings reported in some studies [18], namely that PN is more common among tall patients. Obese subjects tend to be shorter and in our study, the mean height of obese individuals was relatively lower, when compared with normal and overweight patients with significant difference. Moreover, most obese cases were females (5.5%) compared to obese male cases (2.0%), with significant difference. Our study found the risk of PN to be associated with males and the risk is about 1.5 folds more than in females.

Although this study included a relatively large number of variables, it did not take into consideration some of the important laboratory parameters such as; serum lipids and cholesterol, and the average glycosylated hemoglobin (HbA_{1C}) that quantify the quality of diabetic control better than the FBG used in this study. These parameters are not included because of their high cost and the low resources available for the study.

The diagnosis of PN among diabetic patients in this study was based only on the Michigan Neuropathy Diabetic Scoring (MNDS) criteria. However, our data results are concordant with the Diabetes Control and Complications Trial (DCCT) [24] and the United Kingdom Prospective Diabetes Study (UKPDS) [25] results, which used nerve conduction (EMG-NCV) to identify neuropathic patients. Therefore, it can be concluded that MNDS criteria can be used with high confidence as an outpatient screening method.

In conclusion, this study found that PN is highly prevalent among diabetic patients attending hospital outpatient clinics in Egypt. Although the associated risk factors observed in this study were consistent with other previous studies, the generalization of these results to general population is questionable, because of the hospital-based data used in this and most of the previous studies. To confirm these results, further studies with community-based data are needed, which take into consideration the effect of factors not included in this study on the risk of PN.

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